



Minimizing MOH contamination in cocoa

a specification for MOSH and MOAH in jute bags

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CONTEXT AND GOALS

Jute sacks are essential in cocoa supply chains due to their durability, breathability, and status as a sustainable packaging solution. To ensure food safety, all jute sacks used for cocoa beans must adhere to the IJ098/01 standard, requiring preparation with vegetable batching oils.

However, the detection of MOSH (mineral oil saturated hydrocarbons) and MOAH (mineral oil aromatic hydrocarbons) in cocoa beans suggests contamination from mineral oil migration during transportation, indicating that current specifications may be insufficient to prevent mineral oil-contaminated jute sacks from entering the supply chain.

The present work aimed to:

- Investigate the current **situation regarding MOSH/MOAH contamination** in the jute bag manufacturing chain.
- Assess the effectiveness of **unsaponifiable matter (USM)** measurement as a tool for detecting MOH contamination in jute.
- Define **conservative specification limits** for MOSH and MOAH in jute bags to ensure compliance of cocoa-derived products with anticipated regulatory standards.

PART I – Current MOSH/MOAH situation in jute bags

MOSH/MOAH CONTAMINATION IN VEGETABLE OIL- AND MINERAL OIL-TREATED JUTE BAGS

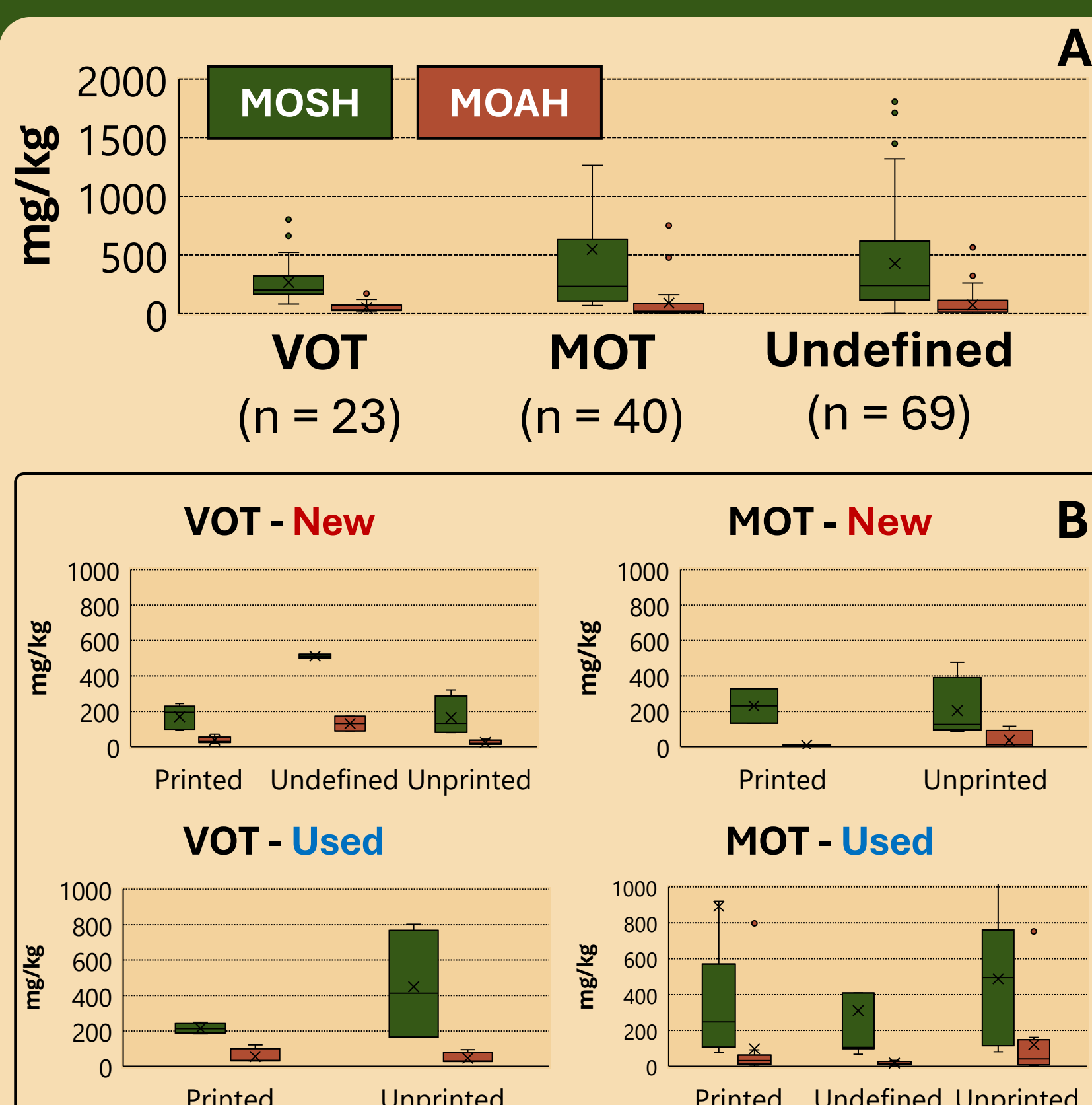


Figure 1 – MOSH and MOAH contents (mg/kg) in vegetable oil-treated (VOT), mineral oil-treated (MOT), and undefined jute bags (A), as well as in sub-groups defined by the level of use (old/new) and the presence of printing (B).

Data collection – Data on MOSH/MOAH content in jute bags was gathered over recent years by companies within the ECA/Caobisco associations, were evaluated, with 132 samples retained for analysis.

ENTRY POINTS OF MOSH/MOAH IN THE JUTE BAG MANUFACTURING CHAIN

Data collection – VOT jute bag producers were instructed to collect samples of jute fibers and bags at various stages of the processing chain, along with batching oils and printing inks. The MOSH/MOAH content in these samples was subsequently analyzed using LC-GC-FID.

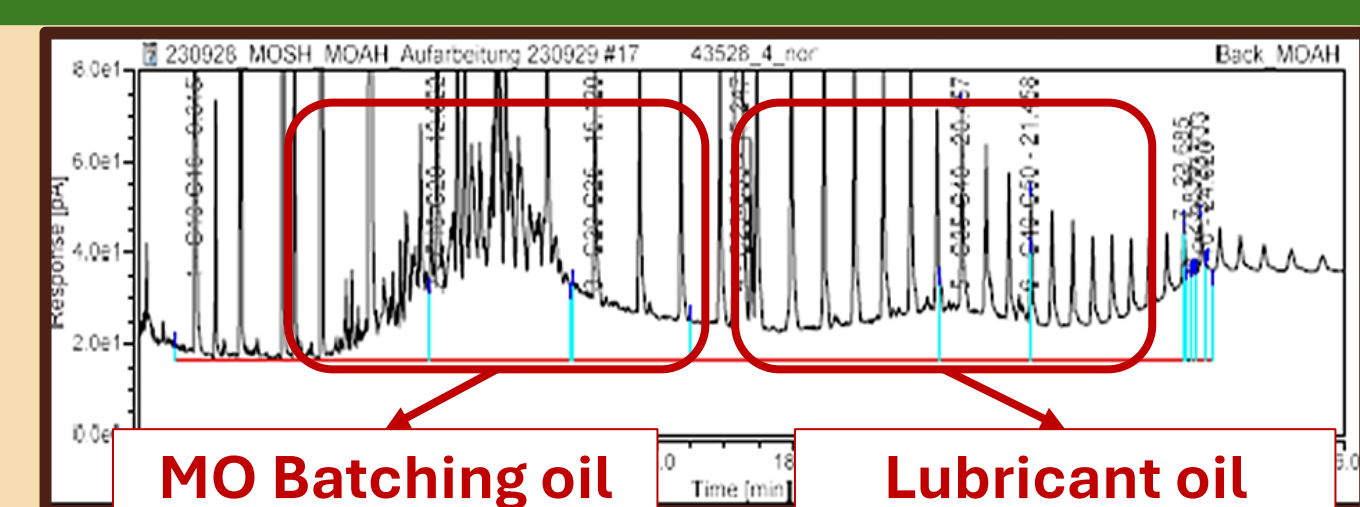


Figure 3 – GC-FID chromatogram of MOSH from a jute bag.

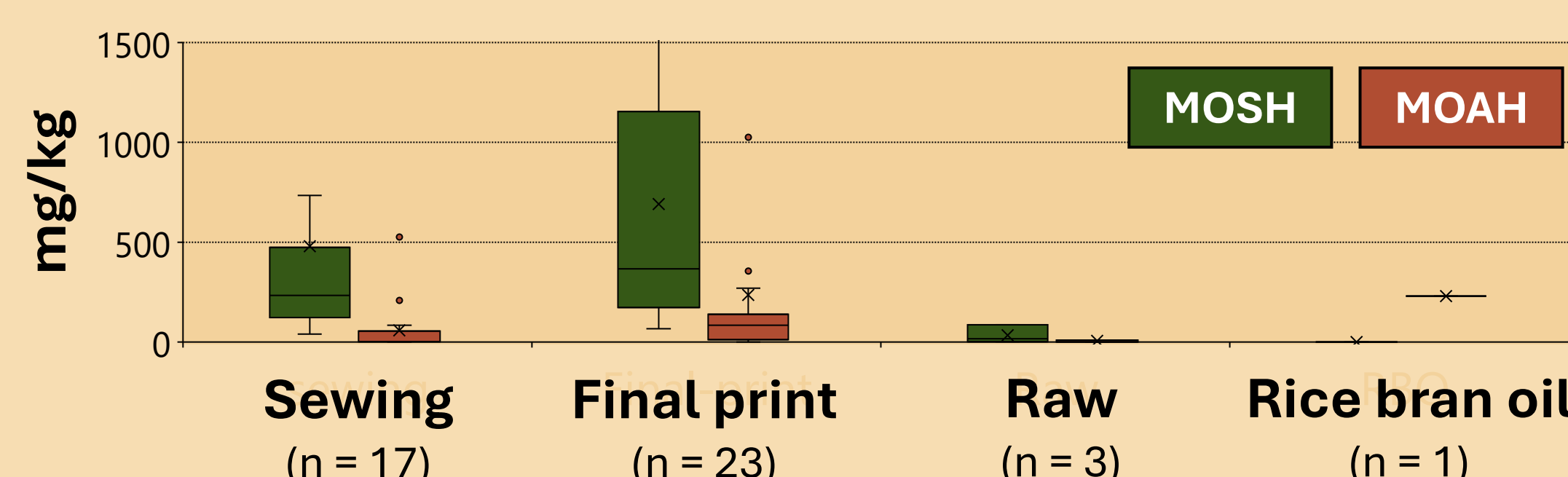


Figure 2 – MOSH and MOAH contents (mg/kg) at various stages of jute bag manufacturing, as well as in a batching oil (rice bran oil, n=1)

The data shows **no significant difference in MOSH/MOAH contamination levels between MOT and VOT jute bags**. While printing inks were not identified as a major source of contamination, attention should be given to avoid mineral oil-based inks. **Used jute bags exhibited slightly higher contamination levels than new ones**, likely due to poor handling during transport and storage. The **limited number and diversity of samples**, however, restricted definitive conclusions, particularly regarding the role of vegetable batching oils in MOH contamination (n=1). Additionally, some samples showed contamination by **MO batching oil and lubricating oil**, suggesting improper handling or storage practices as contributing factors.

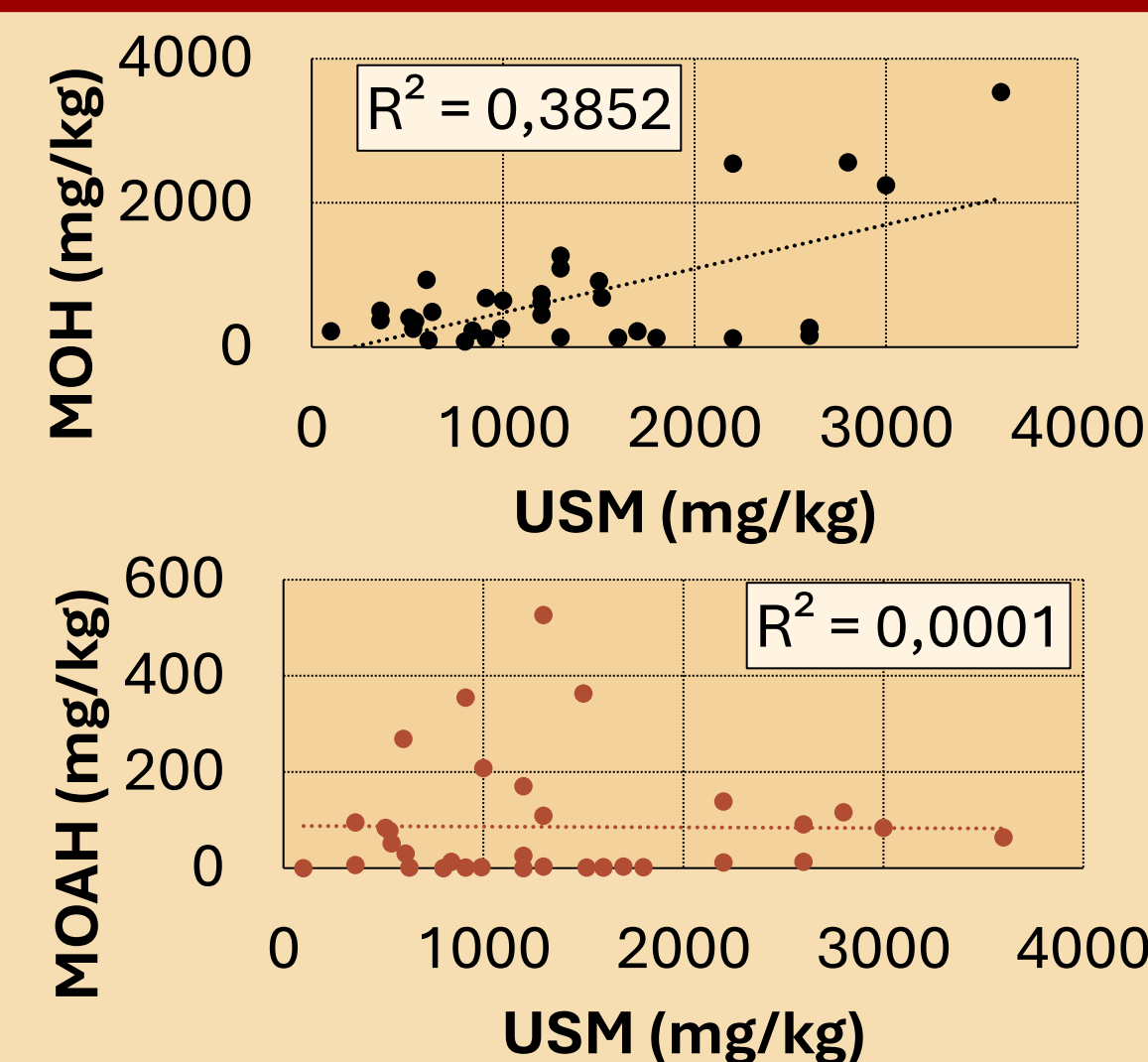
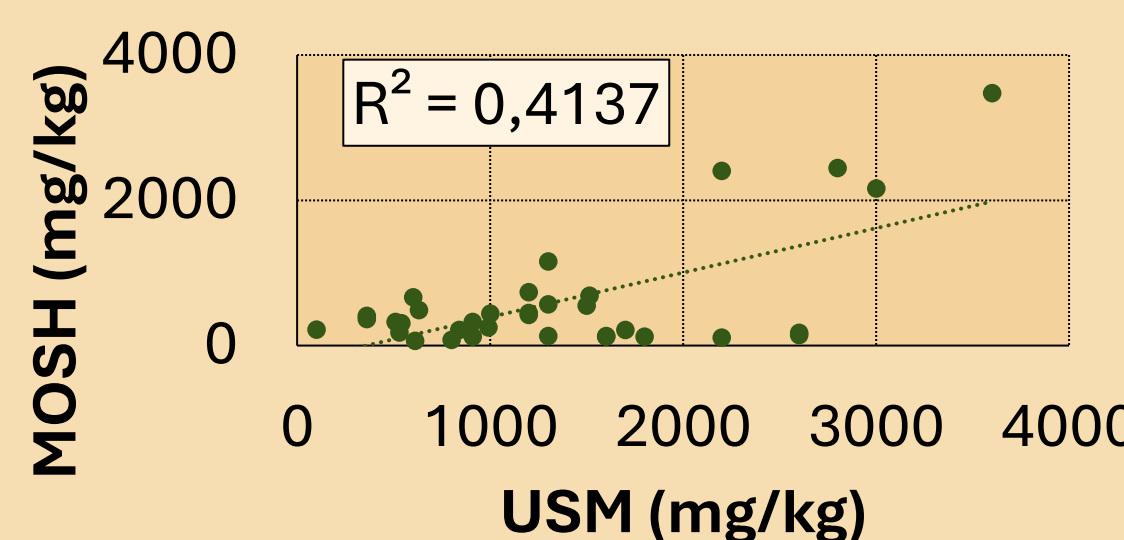
PART II – UNSAPONIFIABLE MATTER AS A MOSH/MOAH COMPLIANCE TOOL?

As recommended by the IJO and EFSA, a USM content below **1250 mg/kg** is expected to ensure safe levels of MOH contamination in jute bags.

To evaluate the reliability of USM as a compliance tool, its correlation with MOSH, MOAH, and total MOH levels was assessed. For visualization purposes their correlation and associated coefficient of determination is shown

Data collection – The jute bags sampled for goal 2 were analyzed in terms of USM according to the IJO 98/01 Standard Method. The USM was determined in 36 samples.

Figure 4 – USM of jute bags vs. MOH (A), MOSH (B), and MOAH (C) content with regression lines.



A very weak correlation was observed between USM and MOH/MOSH levels, and no correlation was found between USM and MOAH levels, indicating that **USM determination is unsuitable for assessing compliance with MOH contamination limits in jute bags.**

PART III – PROPOSAL OF SPECIFICATION LEVELS FOR MOSH/MOAH IN JUTE BAGS

The presence of MOSH/MOAH contamination in jute bags, despite expected adherence to IJO 98/01 requirements, highlights the need for stricter controls through the establishment of specification limits. These limits should ensure that cocoa-derived products in contact with jute bags remain compliant with current advised MOAH thresholds and the expected indicative MOSH action limit.

The combination of this **kinetic data** (based on studies performed in 2021) with **conversion yields** were employed to estimate the **maximal MOSH/MOAH contents in jute** that would comply with future specifications in chocolate and confectionery.

Conversion yields from nibs to cocoa-derived products

Cocoa liquor (~50-55% fat) = total as for nibs
Cocoa butter (100% fat) = nibs/0.54
Cocoa powder (~10-12% fat) = nibs*(0.11/0.54)

Current advised maximum levels for MOAH *

- 2 mg/kg** for fats/oils
- 1 mg/kg** for foods with 4-50% fat content

* Reference: Standing Committee on Plants, Animals, Food and Feed Section Novel Food and Toxicological Safety of the Food Chain (19 October 2022)

<https://circabc.europa.eu/ui/group/55b2edd3-069e-40fd-ad4a-8b163f54ff1f/library/f0505934>

	MOSH	MOAH
Specification limit jute bags (mg/kg)	250	25
Expected max migration (mg/kg)	Cocoa liquor	2.8
	Cocoa butter	5.2
	Cocoa powder	0.6
		0.1

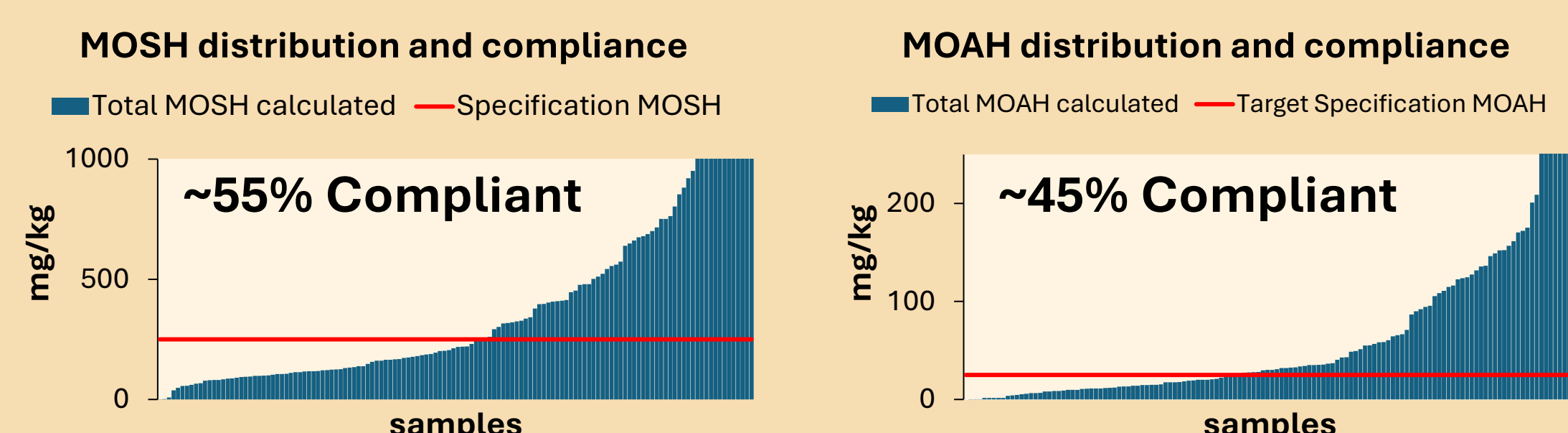


Figure 5 – Distribution of the MOSH and MOAH occurrence in jute bags (n=169) in relation to expected MOSH action limits (here considered as 10 mg/kg) and to current MOAH specification levels.